

CLAIMS:

1. A magnetic head for effecting at least one of the write and read operations of data into and from a magnetic medium, wherein part of an air bearing surface thereof with said medium is machined by focused ion etching.
2. A magnetic head according to Claim 1, wherein the track width of head magnetic poles is defined by the width of a projecting portion disposed on said air bearing surface.
3. A magnetic head according to Claim 1, wherein said magnetic head is a self read/write induction type thin film head and includes upper and lower magnetic poles laminated through an electromagnetic insulation layer and forming a magnetic path, and a conductive coil disposed inside said insulation layer and inputting and outputting signals, and the difference of the track width between said upper and lower magnetic poles is below $0.1\text{ }\mu\text{m}$.
4. A magnetic head according to Claim 2, wherein said magnetic head is a read/write thin film head and includes upper and lower magnetic poles laminated through an electromagnetic insulation layer and forming a magnetic path, a conductive coil disposed inside said insulation layer and inputting signals and a read head having a magnetoresistive film having electrodes for power supply, and the track width of said read head is smaller by at least $0.1\text{ }\mu\text{m}$ than the track width of said upper and lower magnetic poles.

5. A magnetic head according to Claim 2, wherein said magnetic head is a read/write thin film head and includes upper and lower magnetic poles laminated through an electromagnetic insulation layer and forming a magnetic path, a conductive coil disposed inside said insulation layer and inputting signals and a read head having a magnetoresistive film having electrodes for power supply, and the track width of said upper and lower magnetic poles is below 3 μm .

6. A magnetic head according to Claim 2, wherein the width of a projecting portion disposed on said air bearing surface is defined by a pair of trenches disposed at part of said air bearing surface, and part or entire portion of said trenches is filled by a non-magnetic material having small specific resistivity.

7. A magnetic head according to Claim 1, wherein the entire surface of said air bearing surface other than the magnetic pole portion of a slider rail is cut off uniformly.

8. A magnetic head according to Claim 1, wherein the entire surface of said air bearing surface other than the magnetic pole portion of a slider rail is cut off uniformly by 20 - 30 nm.

9. A magnetic head according to Claim 1, which is cut off in such a manner that the thickness of the tip of said magnetic pole becomes small.

10. A fabrication method of a magnetic head for effecting at least one of the write and read operations

of data into and from a magnetic recording medium, said method characterized in that part of the surface opposing said medium is machined by focused ion beam etching.

11. A fabrication method of a magnetic head according to Claim 10, wherein said magnetic head includes a slider for floating hydrodynamically said magnetic head on said recording medium and upper and lower magnetic poles laminated through an electromagnetic insulation layer disposed on said slider, and forming a magnetic path, and focused ion beam etching is carried out by depositing a conductive thin film on said slider portion.

12. A fabrication method of a magnetic head according to Claim 10, wherein said magnetic head includes a slider for floating hydrodynamically said magnetic head on said recording medium and upper and lower magnetic poles laminated through an electromagnetic insulation layer disposed on said slider, and forming a magnetic path, and focused ion beam etching is carried out by irradiating an electron beam to said slider portion.

13. A fabrication method of a magnetic head according to Claim 10, wherein a pair of trenches are formed on the surface opposing said recording medium by focused ion beam etching and the track width is defined by said trenches.

14. A fabrication method of a magnetic head according to Claim 13, wherein focused ion beam etching is carried out in an atmosphere containing an electrically

conductive element so as to form a layer of said conductive element at the portion to which the focused ion beam is irradiated, and a metal is packed into said trenches by applying field plating to the portion of the layer of said element.

15. A fabrication method of a magnetic head according to Claim 13, wherein focused ion beam etching is carried out in an atmosphere containing an electrically conductive element so as to form an injection layer of said conductive element at the portion to which the focused ion beam is irradiated, and a metal is packed into said trenches by applying field plating to said injection layer of said element.

16. A fabrication method of a magnetic head according to Claim 10, wherein said magnetic head includes a slider for floating hydrodynamically said magnetic head on said recording medium and upper and lower magnetic poles laminated through an electromagnetic insulation layer disposed on said slider and forming a magnetic path, and after the surface of said slider opposing said recording medium is polished, the opposed surface other than said magnetic pole portions is cut off uniformly by focused ion beam etching.

17. A fabrication method of a magnetic head according to Claim 10, wherein said magnetic head includes upper and lower magnetic poles laminated through an electromagnetic insulation layer and forming a magnetic path, and either one of said upper and lower magnetic poles is

cut off from its surface opposing said recording medium by focused ion beam etching so as to fabricate a unipole type head for vertical magnetic recording.

18. A composite magnetic head comprising a magnetoresistive head including a soft magnetic thin film having a magnetoresistive effect and soft magnetic members interposing said soft magnetic film through a non-magnetic insulation layer, an induction type head including magnetic poles formed in a moving direction of a medium in the proximity of said magnetoresistive head and a conductor crossing said magnetic poles and a substrate for supporting both of said heads, said composite magnetic head characterized in that part of a floating surface including said magnetic head constituent members has recesses, and write and read operations into and from said medium are effected by the portion interposed between said recesses.

19. A magnetic head according to Claim 18, wherein the width of the floating surface interposed between said recesses in a direction vertical to the moving direction of said medium is different between said write head portion and said read head portion and is smaller in said read head portion.

20. A magnetic head according to Claim 18, wherein part or the whole of said soft magnetic film constituting said magnetoresistive head functions also as the magnetic poles of said write head.

21. A magnetic head according to Claim 18, wherein

a layer made of Ti, Cr, C or their compound is disposed at part of the portion between a non-magnetic insulation layer constituting said write head and an upper electrode.

22. A fabrication method of a magnetic head comprising the following steps:

- (1) forming a magnetoresistive read head including a soft magnetic thin film having a magnetoresistive effect and soft magnetic members interposing said soft magnetic thin film from both sides between them through an insulation layer on a substrate constituting said magnetic head, and laminating an induction type write head including magnetic poles and a conductor pattern crossing them on said read head;
- (2) cutting said substrate having both of said heads mounted thereon into a desired shape and exposing the constituent members of both of said heads on the section as an opposing surface a recording medium; and
- (3) forming recesses at part including the constituent members of both of said heads exposed on said medium opposing surface, and forming the constituent members of both of said heads interposed between said recesses.

23. A magnetic head including upper and lower magnetic poles laminated through an electromagnetic insulation layer and forming a magnetic path and a conductor coil disposed inside said insulation layer and inputting

and outputting signals, characterized in that the thickness of at least one of said upper and lower magnetic poles is reduced at the tip thereof opposing a magnetic recording medium.

24. A magnetic head according to Claim 23, wherein the thickness of at least one of said magnetic poles is reduced at the tip thereof opposing a magnetic recording medium in a depth of from 0.3 to 0.8 μm from said medium opposing surface.

25. A magnetic head according to Claim 23, wherein the thickness of at least one of said magnetic poles is reduced at the tip thereof opposing a magnetic recording medium in a depth of from 0.4 to 0.6 μm from said medium opposing surface.

26. A magnetic head according to Claim 23, wherein the thickness of said magnetic poles opposing a magnetic recording medium is from 0.3 to 0.8 μm and is smaller than the thickness at other portions.

27. A magnetic head according to Claim 23, wherein the thickness of said magnetic poles opposing a magnetic recording medium is from 0.4 to 0.6 μm and is smaller than the thickness at other portions.

28. A magnetic head according to Claim 23, which satisfies the relation $t_2 < g_2$ where t_2 is the length of the portion at which the film thickness of the tip of said magnetic pole is reduced and g_2 is the distance from the tip to the position of each of said upper and lower magnetic poles at which the gap between the magnetic film

expands.

29. A fabrication method of a magnetic head comprising:

a step of depositing at least a magnetic layer, a conductor layer and an insulation layer on a substrate;

a thin film head fabrication step of patterning each of said deposited layers into a predetermined pattern; and

a step of irradiating a focused ion beam in a vertical direction from a medium opposing surface of said head to a medium, so as to etch the film thickness of said magnetic layer in a predetermined width and thereby to reduce the film thickness of said upper and lower magnetic layers on only on the medium opposing surface at the tip of magnetic poles.